

SYSTEM FOR REGISTERING COMPONENT IMAGE TILES IN A CAMERA-BASED SCANNER DEVICE TRANSCRIBING SCENE IMAGES

CROSS REFERENCE TO RELATED APPLICATIONS

This is a continuation, of application Ser. No. 08/353,654, filed Dec. 9, 1994, now abandoned.

This application is a related to U.S. Patent application Ser. No. 08/303,929, and U.S. Patent application Ser. No. 08/303,918, each concurrently filed and coassigned.

FIELD OF THE INVENTION

The present invention relates to calibrating a device for producing an image of a scene such as a whiteboard, a desktop, an open book, or a general scene in electronic form.

More specifically, the invention relates to projected alignment patterns for registering component image tiles in a scene scanning system, wherein the system provides a digital composite image to produce a complete, undistorted, high-resolution image of the entire whiteboard.

BACKGROUND OF THE INVENTION

In the present invention, a method is presented for producing high-resolution composite images of surfaces, generally applicable to the task of imaging surfaces which are not too distant from the camera. Examples of particular applications are high-resolution, digital desktop imaging, and high-resolution open book scanners. Another important example application is imaging of a whiteboard surface. In the following discussion, the idea is illustrated by detailed discussion of the application of high-resolution imaging of whiteboards, with the intent that it illustrates the central elements of the invention which may be applied to a more general case.

In collaborative working environments, several users frequently wish to view and manipulate displayed information simultaneously. Whiteboards are widely used to maintain hand drawn textual and graphic images on a "wall-size" surface. The whiteboard medium offers certain properties that facilitate a variety of interactive work practices: markings are large enough to be viewed by several people; markings can be edited by erasing and redrawing; the surface is immobile, so does not get lost, crumpled, torn, or blown by wind; the surface is readily erased, is completely reusable, and (practically) does not wear out. However, one drawback to using a whiteboard is that information is not easily transferred to other media. Thus, it is not currently possible to hold a conversation with someone while maintaining a record of the conversation in text and graphics on a whiteboard and then quickly, easily, and automatically transfer the record to paper or other portable and storable medium.

Existing methods for accomplishing this task are cumbersome, time-consuming, and inconvenient. One can simply transcribe by hand, onto paper, any or all of the text and graphics residing on the whiteboard. This can be time-consuming, and suffers from errors due to mistakes in human reading and writing. Or, one can photograph the whiteboard with a camera. This requires having a camera at hand, introduces the delay of developing the film, can be expensive if an "instant" camera is used, is subject to poor quality rendition due to improper focus and exposure. A

camera further usually produces an image of greatly reduced size that can be difficult to read.

Alternatively, "wall-size" sheets of paper, such as poster pads, lead to a relatively permanent and portable record of what was written, but these sheets of paper are large and cumbersome, and do not permit easy erasure during image creation.

A copy-board device provides a writing surface which can be transcribed into paper hardcopy, but these are currently conceived as conspicuous portable whiteboards that displace rather than leverage existing, built-in whiteboards.

The solutions discussed above further do not aid in transferring the image from the whiteboard into an electronically usable form. Concurrently filed U.S. Pat. application Ser. No. 08/303,918 describes a system for scanning a whiteboard or blackboard to capture an image. Such a system works by combining a series of image "tiles", or individual camera shots of portions of the board, into a composite image of the board.

The present invention may be used to provide registration information for combining the image tiles into a composite image. In the present invention, an alignment pattern is projected upon a whiteboard to provide electronic registration and calibration of the tiles of the surface image by a camera-based scanning system, so that a high-resolution electronic image of a scene may be provided without significant distortion.

The present invention further allows such calibration patterns to be projected and processed independent of the user of the scene scanning system. The invention may employ infrared light projection, so that the registration information is invisible to the user of the system.

SUMMARY OF THE INVENTION

The present invention provides a system for scanning scene images into electronic images. The system includes a camera subsystem for capturing the scene image in a plurality of image tiles, each tile capturing a portion of the whiteboard, and a projector for projecting a registration light pattern upon the whiteboard. The present invention also includes a method for registering the relative alignments of image tiles, in which a registration light pattern is projected upon the scene into each tile. The light pattern in each tile is captured, and used to determine alignment of pairs of neighboring tiles. The alignment of each pair of tiles is combined with the alignment information of all the tiles to produce a composite alignment of the entire whiteboard image.

One aspect of the present invention is the ability to project calibration markings on the scene which may be used independently of the scene image to construct a high-resolution electronic image of a scene without significant distortion.

When infrared (IR) light is projected to provide the registration pattern, the registration marks are not visible to distract the user, but may always be present for the system to perform its calibration calculations without requiring other input, such as marks in tile overlap areas, from the user.

The following description, the drawings and the claims further set forth these and other objects, features and advantages of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a system including the features of the present invention.